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Spin of 4.8 Mev level of Be^8

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An ordinary lithium target has been bombarded with 500Kev deuterons from the Cockroft-Walton high tension machine at the Tata Institute of Fundamental Research, Bombay. The outgoing neutrons were collected on 400μ thick Ilford G5 nuclear research emulsion plates at seven angles, *viz.* 0°, 45° 60°, 90°, 120°, 135° and 150°. The neutron yield at seven angles corresponding to 4.8Mev level of Be^8 was experimentally found. This value was compared with the predicted neutron yield from the theory of Butler. Of the various curves drawn for the yield at the different values of the proton angular momentum transfer the curve at $l_p{}^1$ showed the closest fit to the observed data. The analysis yields that the spin of the 4.8Mev level of Be^8 is 0 or 2 and of even parity.

Introduction

The spin of the 4.8 Mev level of Be^8 has been deduced from the consideration of the angular distribution of the neutrons from the nuclear reaction Li+d. The experimentally observed angular distribution of neutrons from 500 Kev deuteron bombardment of lithium, has been compared with the various such curves obtained from the theory of Butler (1967) for various values of the proton angular momentum transfer (l_p). A comparision of the experimental and calculated values shows the closest fit with $l_p = 1$. This gives the spin 0 or 2 and even parity for this level.

Experimental Method

An ordinary lithium target 96 Kev thick on 0.013 cm copper backing, has been bombarded with 500 Kev deuterons from the Cockroft and Walton high tension machine at the Tata Institute of Fundamental research, Bombay The outgoing neutrons were collected at seven angles on 400μ Ilford G5 nuclear research emulsion plates. The emulsion plates were then processed by the method of "Temperature Cycle" of Dilworth *et al* (1948) and were scanned under Cooke Troughton & Simms Nuclear Research Microscope ($\times$ 1200). All the tracks which were produced after the reaction within a solid angle of 5° from the direction of neutrons and originated between 50μ to 350μ thickness of the emulsion plate and exceed a certain length were measured. The neutron yield in terms of the number of events/$10^9\mu^3$ at seven angles, corresponding to the 4.8 Mev level, was transferred to the centre of mass system of coordinates by using the formula of Haxby *et al* (1939) and normalised in the forward direction ($\theta = 0$) and plotted on the graph in dashed lines with the statistical variation shown at each angle.

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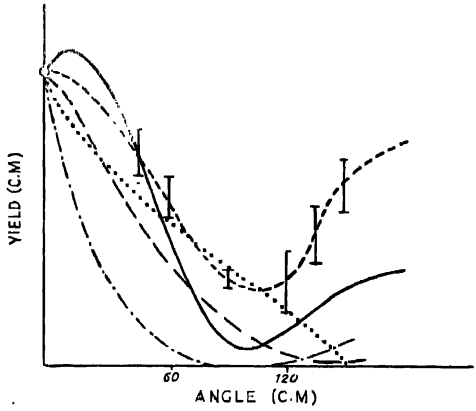

Figure 1

Discussion of the Results

The neutron yield does not show any fore-and-aft symmetry as is expected from Bohr's theory of the formation of the compound nucleus (Evans 1955). The neutron yield shows a pronounced forward maximum, suggesting that the Oppenheimer-Phillips (1935) process of stripping of the nucleus has been mainly responsible for the interaction between the deuteron and the target nucleus. Herein a proton of the deuteron interacts directly with the lithium nucleus and forms the Be^8 nucleus. The other nucleon of the deuteron, *i.e.*, the neutron goes off with the residual energy and momentum. Though the energetics of the compound nucleus formation and the stripping process are the same, the angular distribution of the outgoing particle is entirely different. An analysis has been made using the theory of Butler (1967) The calculated values of neutron yield for the proton angular momentum transfer values 0,1,2 and 3 have been calculated. The data for $l_p = 0$ has been shown by the dot-dash curve on the figure. The continuous curve shows the data for $l_p = 1$. The neutron yield data for $l_p = 2$ is shown as long dashes. This can be distinguished from the short dash data representing the experimentally observed values having the probable values. The data for $l_p = 3$ is shown by a dot curve.

The curve for proton angular momentum transfer value $l_p = 1$ shows the closest fit for the observed data as shown in the figure. It suggests that the proton with an orbital angular momentum value 1 ($l_p = 1$) is directly assimilated in the nucleus of lithium and the outgoing neutrons take the residual energy and the angular momentum. This gives the spin of 4.8 Mev level of Be^8 to be 0 or 2 and of even parity.

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